Computer Architecture

-MIPS Assignment

A. Lokesh-IMT2022577

A. Nishith-IMT2022556

The program we have chosen is Simple encryption and decryption.

<u>MIPS program explanation:</u>

The program contains text segment and data segment.

The data segment contains statements which are used as prompts.

The text segment contains the implementation of encryption and decryption of data using XOR operation.

Firstly, we take input of encryption key from the user and store it. And then we take input of address where the data to be stored. Now after taking data from the user, we store it in memory. Now we take storage addresses for encrypted data and decrypted data respectively. Then, we apply XOR operation of data with the encryption key and store it in the memory location

specified by the user. For decryption we again apply the XOR operation of each byte with encryption key and get back the decrypted data.

Finally, we print the encrypted and decrypted data.

Assembler Explanation:

First, we made a dictionary for all used MIPS keywords and registers. We go through the entire MIPS code and read each line. We used a series of conditional statements to get appropriate machine code for every instruction.

Output Screenshots:

/home/anishith/Desktop/CA_MARS/mips1.asm - MARS 4.5

File Edit Run Settings Tools Help

Run speed at max (no interaction)

Edit Execute

Text Segment

Bkpt	Address	Code	Basic	Source
	4194304	0x0c100022	jal 4194440	12: jal print_key_prompt
	4194308	0x0c100027	jal 4194460	13: jal input_int
	4194312	0x21aa0000	addi $10,$13,0	15: addi $12,$t5,0
	4194316	0x10002b	jal 4194476	17: jal print_data_address_prompt
	4194320	0x0c100027	jal 4194460	18: jal input_int
	4194324	0x21ab0000	addi $11,$13,0	20: addi $t3,$t5,0
	4194328	0x0c100030	jal 4194496	22: jal print_data_input_prompt
	4194332	0x0c100035	jal 4194516	23: jal input_string
	4194336	0x0c1003a	jal 4194536	25: jal encrypt_address_prompt
	4194340	0x0c100027	jal 4194460	26: jal input_int
	4194344	0x21ac0000	addi $12,$13,0	28: addi $t4,$t5,0
	4194348	0x0c10003f	jal 4194556	30: jal decrypt_address_prompt
	4194352	0x0c100027	jal 4194460	31: jal input_int
	4194356	0x21b00000	addi $24,$13,0	32: addi $18,$t5,0
	4194360	0x200f0000	addi $15,$0,0	35: addi $17,$0,0
	4194364	0x81680000	lb $8,0($11)	38: lb $t0,0($t3)
	4194368	0x2001000a	addi $1,$0,10	39: beq $t0,'\n',resetAddress

Data Segment

Address	Value (+0)	Value (+4)	Value (+8)	Value (+12)	Value (+16)	Value (+20)	Value (+24)	Value (+28)
268500992	1850015754	544367988	1919118949	1769238649	1797287535	540703077	1953383680	1931506277
268501024	1953653108	543649385	1919181921	544437093	2032166511	544372079	1635017060	1157636154
268501056	1919251546	1635021600	1852404850	1684086887	1936028268	1718558835	1668179232	1953528178
268501088	1679844453	979465313	1850015776	544367988	1918989427	1735289204	1684300064	1936942450
268501120	543584032	1919116644	1952804985	1633951844	540696948	1953383680	2032169573	544372079
268501152	1635017060	544175136	1696621922	2037539694	1684370544	1157636154	2037539694	1684370544
268501184	1952539680	2112097	1667500938	1953528178	1679844453	979465313	32	1
268501216	0	0	0	0	0	0	0	0
268501248	0	0	0	0	0	0	0	0
268501280	0	0	0	0	0	0	0	0
268501312	0	0	0	0	0	0	0	0
268501344	1701998198	2036820073	2663	0	0	0	0	0
268501376	0	0	0	0	0	0	0	0
268501408	1635150450	2103667821	99	0	0	0	0	0
268501440	1701998198	2036820073	103	0	0	0	0	0

0x10010000 (.data)   [ ] Hexadecimal Addresses   [ ] Hexadecimal Values   [ ] ASCII

Registers | Coproc 1 | Coproc 0

Name	Number	Value
$zero	0	0
$at	1	268500992
$v0	2	4
$v1	3	0
$a0	4	268501448
$a1	5	100
$a2	6	0
$a3	7	0
$t0	8	0
$t1	9	103
$t2	10	4
$t3	11	268501344
$t4	12	268501408
$t5	13	268501440
$t6	14	0
$t7	15	0
$s0	16	0
$s1	17	0
$s2	18	0
$s3	19	0
$s4	20	0
$s5	21	0
$s6	22	0
$s7	23	0
$t8	24	268501440
$t9	25	0
$k0	26	0
$k1	27	0
$gp	28	268468224
$sp	29	2147479548
$fp	30	0
$ra	31	4194356
pc		4194640
hi		0
lo		0

Mars Messages | **Run I/O**

```
Enter encryption key: 4
Enter starting address of your data: 268501344
Enter your data to be encrypted: vnreihgyg
Enter starting address of encrypted data: 268501408
Enter starting address of decryptd data: 268501440
Encrypted data: rjvamlc]c
Decrypted data: vnreihgyg
-- program is finished running (dropped off bottom) --
```

Clear

mips1.asm - CA_MARS - Visual Studio Code

File Edit Selection View Go Run Terminal Help

EXPLORER

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

> CA_MARS
  > Mars4_5
    #Avery Zamzow
    assembler.py
    binary
    Example_loop.asm
    Mars4_5.jar
    mips1.asm

```
anishith@anishith-HP-Pavilion-Laptop-15-eg2xxx:~/Desktop/CA_MARS$ /bin/python3 /home/anishith/Desktop/CA_MARS/assembler.py
00001100000100000000000100010
00001100000100000000000101111
00100001101010100000000000000
00001100000100000000001011011
00001100000100000000000101111
00100001101010110000000000000
00001100000100000000001110000
00001100000100000000001110101
00001100000100000000001111010
00100001101011000000000000000
00001100000100000000001111111
00001100000100000000001101111
00100001101110000000000000000
01000000001111000000000000000
10000000101101000000000000000
00100000101001000000000001010
00101000010100000000000000110
00000010100100010000000100110
10100001100100100000000000000
00100001101101010000000000001
00100011100011000000000000001
01000011110011110000000000001
00001000001000000000000001111
00000010110111101101110000010
00001100001110110000000100010
00010000001100000000000001011
10000001110010000000000000000
00100001000000000000000100111
00000001010010010010000100110
10100011100100100000100100000
01000010110001000000000000001
00100001100011000000000000001
00010010010010000000000001011
01000000000010000000000000100
00111100000010010000000000100
00110100001100100000000000010
00000000001001000000000001100
00000111110000000000000001000
00100001001001000000000000101
00100000100101101000000000000
00000011110000000000000001000
01001000000001000000000000100
00111100000010010000000000001
00110100001100100000000000010
00000111110000000000000001000
00100001001001000000000000100
00111100001001000000000000001
00110100001100100000000100010
00000011110000000000000001000
00100001001001000000000000100
00111100001001000000000011110
00000010000000000000000001100
00000111110000000000000001000
00100001001001000000000000000
00100000100100100000000100100
00000000001010000000000001100
00000011110000000000000001000
01111000000001000000000000001
00111000000010010000000000100
00111010000100100000000001000
```

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00000011110000000000000001000
00111110000010000000000001100
00111100000010010000000000100
00110100001001100000000110011
00000011110000000000000001000
00000011100111101101100000010
01000000000010000000000000100
00111100000010010000000000001
00110100001100100000000000100
00100010000100100000000001100
00000100000100000000000001100
00000011110000000000000001000
00000011000111111110000100010
00100000100100100000000000001
00111110000010000000000001010001
00110100001001010000001010001
01000000000010000000000001100
00100010000100100000000001100
00100001001001000000000000000
00000011110000000000000001000
anishith@anishith-HP-Pavilion-Laptop-15-eg2xxx:~/Desktop/CA_MARS$
```